

## THE DEVELOPMENT OF CHEMISTRY ADVENTURE (CHEMTURE) GAME AS LEARNING MEDIA ON CHEMICAL BONDING MATTER FOR HIGH SCHOOL STUDENT

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### Abstract

The aim of the research is to produce feasible Chemistry Adventure game as a learning media on Chemical Bonding matter for high school students. The feasibility are reviewed based on validity, practicality, and effectiveness of Chemistry Adventure game. The validity is determined from results of the assessment of contents and construct validity by three validators, the practicality is determined by results of activities observation and response questionnaire of student, while the effectiveness is determined from the learning outcome of students and interest in learning of students. This research is development research using Research and Development (R&D) design with one group pretest and posttest method which is limited trial test was conducted to 33 students of 10<sup>th</sup> grade of SMAN 1 Sidoarjo, East Java. The result of content and construct validity for every aspect obtained percentage of 73.33% to 86.67% in valid to very valid category. The result of activity observation of students shows relevant activity that obtained percentage of 88.06% and response of students obtained percentage of 89%. Learning outcome of students shows classical completeness of 90.91% and interest in learning of students was classified as high category with average percentage of 83.76%. Based on the research result can be concluded that Chemistry Adventure game is feasible to be used as learning media.

**Keywords:** Game, Chemistry Adventure, Chemical Bonding.

### INTRODUCTION

The role of teachers as learning facilitator is expected can monitored the level of learning difficulties of students [1]. To overcome those difficulties, teachers can utilize learning media. Media is all of things that can be used to distribute message from sender to receiver so it can stimulate mind, feeling, interest, and attention of students then learning process occurs [2]. The media as a way of teaching content, and the media as communication; considering both the constructivist model, which puts the emphasis on learning rather than on teaching, and on students constructing their own knowledge from what we give them, being able to acquire information within the chaos [3].

One of the learning media is game which is an audiovisual media [4]. If game is utilized tactfully and appropriate can discard stress in learning environment, stimulate students to fully engaging, and increase enthusiasm in learning process [5]. The game players on average between 12 to 30 years with the percentage of 80% aged 12 to 21 years are teenagers [6]. It can be interpreted that high school students are

included in the age category that is very fond of playing.

Games that have educational content are better known as educational games [7]. Computer based educational games have potential as a learning environment because they are a form of play that motivates students through entertainment elements [8]. When students play computer based educational games, students more easily absorb what is in the game and students are more enthusiastic in learning [9].

The use of computer as learning media has opened up great opportunities in the development of learning in certain fields such as chemistry learning. Chemical Bonding is one of the chemistry matter taught for 10<sup>th</sup> grade. Chemical Bonding matter is a broad subject with concepts and descriptions, so that in this subject is needed serious understanding [10]. The difficulty of students in studying chemistry is based on the difficulty of understanding chemistry concepts [11]. Based on the results of the pre-research questionnaire, as many as 83% of students in 11<sup>th</sup> grade and 75% of students in 10<sup>th</sup> grade SMAN 1 Sidoarjo have low

understanding of the Chemical Bonding matter. Students have not been able to apply the concept of chemical bonds and tend to rely on memorization. Students admit that in the learning process, they only hear and record the explanations from the teacher which are used by the blackboard or power point as the medium.

This is supported by observation that when learning activities take place, students tend to be passive, reluctant to pay attention to the teacher's explanation, and even choose to play games. Monotonous learning makes students indifferent. Facts show that when the teacher gives a problem to solve, most students choose to copy their friends' answers. Some even choose not to work on the questions given and instead do other tasks that are not given by the teacher. Students seem bored and not interested in resolving the problem. The lack of problem solving activities has the potential to cause learners incompleteness [12].

Problem solving activities are intended so that students have higher dexterity or skills than what is learned. [13]. In problem solving activities must include feedback elements to correct mistakes made by students so that knowledge is formed which is ready to be used by students at any time [14].

Problem solving activities can be given through the game. Not only avoids boredom, excited learning activities using games will leave a long impression in the memory of students and provide opportunities for students to learn with a more pleasant atmosphere without leaving the learning objectives [15]. In addition to giving problem solving activities in a way that is not monotonous, seems challenging, and fun, the game has great potential in building students' interest in learning. In learning activities, students who have a high interest in learning will feel happy and interested in the subject matter provided by the teacher [16].

Therefore, it is necessary to develop a game as a learning media on Chemical Bonding matter that can be applied during learning activities in schools. The game is a Chemistry Adventure game adapted from the Super Mario Run game with modifications to the challenges, goals and rules of the game. The Chemistry Adventure game contains problem solving activities that are equipped with Chemical Bonding matter. This game will be made on a PC or personal computer platform. Supported by survey results in class X MIPA and XI MIPA 3 that students tend to want computer based games

rather than mobile games or android games. Some of the reasons are computer's screens or laptops/notebooks larger than mobile phones, the visibility of the eyes to the computer screen is more controllable, and the computer has much more RAM.

Based on the description above, the purpose of this research is to obtain a feasible Chemistry Adventure game as a learning media that is viewed from criteria of validity, practicality, and effectiveness.

## METHOD

This research is development research using Research and Development (R&D) [17] design with one group pretest and posttest method which is limited trial test. This research method includes the preliminary study stage and the development stage are described as follows.

### 1. Preliminary Study Stage

This stage is initial stage or preparation for development consisting of 3 steps.

#### a. Literature review

Study to learn concepts or theories relating to the game that will be developed. The activities carried out are studying learning theories relating to learning using games, characteristics of students, and the results of relevant previous research.

#### b. Field Survey

Stage of collecting data regarding the planning and implementation of learning in school, especially relating to the development of learning media. This stage is conducted through an interview with a chemistry teacher and giving questionnaires to students.

#### c. Preparation of Initial Game Products

At this stage, draft of the game is obtained. This game will be used as a learning media in the form of problem solving activities and equipped Chemical Bonding matter. The draft is then reviewed by expert. In this process there are several steps described as follows.

- 1) Game review, this is conducted at the initial draft of the game which serves to get comments, criticisms, and suggestions from expert.
- 2) Game improvement, this will be conducted to improve the initial draft of the game according to advice and input from expert.
- 3) Game validation, this is conducted by 3 experts after the game has revised. Validation is carried out on two aspects, namely content validity and construct validity. Percentage of validity is obtained by comparing scores

from the results of data collection from all validators with criteria scores. Assessment uses calculation from the Likert scale presented in Table 1.

**Table 1.** Likert scale

Score	Criteria
1	Invalid
2	Less Valid
3	Valid Enough
4	Valid
5	Very Valid

[18]

Furthermore, the data is calculated using the formula:

$$PV = \frac{\text{Total score}}{\text{Criterion score}} \times 100\%$$

Information:

PV = percentage of validity

The criterion score is obtained from the highest score  $\times$  number of validators. The Chemistry Adventure game that was developed is said to be valid if in the assessment of validator gets percentage results of  $\geq 61\%$  in valid to very valid category.

- 4) Re-fixing the game, this is conducted if the validation results have not met the category, then the game have to revise and it is revalidated until the values in valid category.

## 2. Development Stage

The development stage is the trial stage of the game. The aim of the trial test is to obtain data on the practicality and effectiveness of the game that was developed. The trial test was conducted to 33 students of 10<sup>th</sup> grade of SMAN 1 Sidoarjo. The test was conducted using One Group Pretest-Posttest Design.

Pretest is used to find out the student's initial understanding on Chemical Bonding matter. Then the students are given treatment namely using the Chemistry Adventure game as a learning media. During the learning activities, observation of students' activities is conducted to find out the practicality of the Chemistry Adventure game. The results of observation are calculated using the formula:

$$PP = \frac{\text{Total Score}}{\text{Total respondent}} \times 100\%$$

Information:

PP = percentage of practicality

After using Chemistry Adventure game, each student is given a posttest sheet. Posttest contains questions that are used to determine the mastery of students on Chemical Bonding matter as the influence of the game as a learning media. To find out the individual completeness, use the formula:

$$IC = \frac{\text{Total score obtained}}{\text{Maximum number of score}} \times 100$$

Information:

IC = individual completeness

To find out the classical completeness, use the formula:

$$CC = \frac{\text{Number of students who complete}}{\text{Total number of students}} \times 100\%$$

Information:

CC = classical completeness

Individual learning completeness is set at  $\geq 75$  according to the minimum completeness criteria of school and classical completeness is set at  $\geq 85\%$  [19].

After posttest, students are asked to fill out a response questionnaire and interest in learning questionnaires. The results of the response questionnaire are used to determine the practicality of the Chemistry Adventure game which can be calculated using the formula:

$$PP = \frac{\text{Total score every statement}}{\text{Number of respondent}} \times 100\%$$

Information:

PP = percentage of practicality

The Chemistry Adventure game is said to be practical if it gets the percentage of  $\geq 61\%$  in a practical to very practical category.

While the results of students' interest in learning questionnaires are used to determine the effectiveness of the Chemistry Adventure game that can be calculated using the formula:

$$PE = \frac{\text{Total score every statement}}{\text{Number of respondent}} \times 100\%$$

Information:

PE = percentage of effectiveness

The Chemistry Adventure game is said to be effective if it gets the percentage of  $\geq 61\%$  in effective to very effective category.

## RESULT AND DISCUSSION

The results of the research and discussion on the development of the Chemistry Adventure game are described as follows.



## 1. Preliminary Study Stage

The preliminary study stage is the initial stage or preparation to get the initial draft of the game which includes 3 steps as follows.

### a. Literature Review

First, the researcher reviewed theories related to learning by using the game as a media. Based on the theories of information processing and constructivism paradigm of learning, the use of media occupies a quite strategic position in order to realize learning activities optimally. The media that used must be fun so it can attract the attention and interest in learning of students. One of them is in the game that is used as learning media.

Second, researchers conducted a study of the characteristics of students in high school age. Based on the results of the study, it was found that students who have entered high school have ages above 11 years or generally aged 15-18 years. High school students are included in the youth category, which they still really like playing, both traditional games and online games [6].

Third, the researcher reviewed the results of relevant previous research. It was found that the use of game as learning media, students are easier to understand the matter by the improvement in their learning outcomes. In addition, the game also affects interest in learning of students because the learning process takes place pleasant, fresh, relaxed, but still conducive.

### b. Field Survey

The researcher conducted a survey to 36 students of 10<sup>th</sup> grade in SMAN 1 Sidoarjo. Based on the results of the survey, as many as 75% of students have a low understanding of the Chemical Bonding matter. Around 86.11% of students stated that they only heard and recorded the teacher's explanation in learning. Regarding students' interest in learning, as many as 75% of students stated that learning takes place monotonously so that they feel lazy and even sleepy when the teacher explains.

Based on the description above, we need a learning media especially in the Chemical Bonding matter that can be used by students to learn and solve problems. The media is expected to make learning conditions more enjoyable and not monotonous. The media is in the form of a game. Through the game, the opportunity of students to enjoy the learning process becomes greater and will be more interesting than conventional learning.

### d. Preparation of Initial Game Products

The researcher composed the script or story that underlies the game flow, made rules and general instructions for the game, arranged the questions related to Chemical Bonding matter in the game based on indicators and learning objectives, and composed a story board and the Chemistry Adventure game guidance. The Chemistry Adventure game guidance contains basic competencies, indicators and learning objectives, a glimpse of the games developed, and how to play the Chemistry Adventure game.

The Chemistry Adventure game is a game that contains problem solving activities and it is equipped with matter that can be used by students as a learning media in the Chemical Bonding matter. In this game, several kinds of assistance were provided, namely assistance in the form of matter, additional time, and elimination. The assistance can be freely chosen by the player by exchanging it with coins they have. Questions in the game were made in multiple choices form with number of 16 questions x 3 levels but players are only required to answer 8 questions correctly at each level.

Based on the three steps taken in the preliminary study stage, the initial draft of the Chemistry Adventure game has been obtained. The next step is review the game by experts to obtain the valid game. The process of reviewing the game is explained in the following stages.

#### 1) Game Review

The study was carried out by experts, namely one chemistry lecturer to get comments and suggestions so that the game that was developed in accordance with the criteria made on the review sheet. The criteria assessed from the aspect of content validity and construct validity. Comments and suggestions that received are matter concepts of the Chemical Bonding which are given too much narration or writing and the design was less attractive. The reviewer gave advice so that the matter is made like a concept map with the design as attractive as possible. The appearance of the narration in the game is very fast. This causes the narration to be completely illegible and it is feared that players do not really understand. After the game review process is complete, the researcher can proceed to the next stage, which is game improvement.

## 2) Game Improvement

At this stage, comments and suggestions obtained from the review process were considered the level of urgency and then improvements were made to the game regarding matters that are not in accordance with the expected aspects. Comments and suggestions provided include improving the chemistry concept in the game so that it is adjusted again with more relevant references, reducing excessive narration on the material, and improving the type and size of the letters to be more clear and enlarged.

## 3) Game Validation

Furthermore, The Chemistry Adventure game that was developed was validated by 3 validators (experts) using the validity sheet instrument. Validation was carried out on content validity and construct validity of the game. Details of the validation results of the Chemistry Adventure game are explained as follows.

### a. Content Validity

Data of the results of content validity were presented in Table 2.

**Table 2.** The results of content validity of Chemistry Adventure game

Aspect	Assessment Indicator	Percent. (%)
The truth of the concept of knowledge.	The concepts in the game are appropriate and correct.	73.33
Have learning objectives.	The matter in the game matches the indicator or goal.	73.33

Based on Table 2, The Chemistry Adventure game that was developed fulfills the first aspect of content validity and got a validity percentage of 73.33% in valid category. This means that matter, especially the Chemical Bonding in the game is correct and in accordance with the rules of chemical science [20]. The Chemistry Adventure game also fulfills the second aspect of content validity and got a validity percentage of 73.33% in valid category. The Chemistry Adventure game was developed to improve the cognitive aspects of students in chemistry matter was adjusted to the indicators.

### b. Construct Validity

Data of the results of construct validity were presented in Table 3.

**Table 3.** The results of construct validity of Chemistry Adventure game

Aspect	Assessment Indicator	Percent (%)
Characteristics of science.	Knowing facts, concepts and theories.	80.00
Encouraging developing special skills.	Encouraging developing basic science process skills (classifying).	73.33
Conformity with the characteristic s of students.	Conformity with the age of students.	73.33
	Conformity with the learning styles of students.	73.33
Have rules.	There are certain rules to succeed in the game.	86.67
There is a guiding element.	Have direction on the game in the form of narration to complete the game well.	86.67
	Encouraging the decision making process to continue playing or not.	80.00
	Engaging students to learn by playing using the game.	86.67
Challenging and actively involving students.	Challenging students to complete the game and get a high score.	86.67
Giving feed back.	Rewards is provided if successful in playing.	80.00

Aspect	Assessment Indicator	Percent (%)
There is a decision making element.	Penalty is provided if it fails in play.	80.00
	There are several choices of answers and continue the game to complete the game.	86.67
Display as a learning media.	Use of existing colors according to the theme	80.00
Software engineering.	The use of animation in the game according to the theme.	73.33
	Software development becomes an effective and efficient game.	80.00
Audio visual communication.	There is continuity between images, narration, back sound, and sound effects.	73.33
	There is continuity from the color and placement of the text with the background given permanan.	80.00

The aspects of science characteristic described in the indicator "Knowing facts, concepts, and theories" got a validity percentage of 80% in valid category. The purpose contained in the assessment indicators is that The Chemistry Adventure game that was developed contains the characteristics of science, namely there are facts, concepts, and theories related to the Chemical Bonding which are packaged in the form of matter that can be learned in the available assistance in the

game. Fact is a truth and the state of an object or noun, and present on what can be observed; concept is an abstraction of events, objects or phenomena that have certain properties or attributes; and theory is an explanation of something that is hidden or cannot be observed directly [21]. Based on the understanding above, examples of facts in the Chemical Bonding matter for example elements can combine to form compounds such as NaCl, MgO, H<sub>2</sub>O. Concepts in the Chemical Bonding matter, for example the concept of atoms, the concept of ion bonds, and the concept of covalent bonds. Theories in the Chemical Bonding matter, for example Lewis's theory.

Aspects of encouraging developing specific skills outlined in the indicator "Encouraging developing basic science processes skill (classifying)" got a validity percentage of 73.33% in valid category. The basic science processes skill consists of 6 skills, namely observing, classifying, predicting, measuring, concluding, and communicating [22]. The Chemistry Adventure game that was developed can encourage students to develop basic science process skills especially the classification skills applied in the questions in the Chemistry Adventure game.

The third aspect of construct validity of each assessment indicator got a validity percentage of 73.33% in valid category. The first indicator is fulfilled because the average of age of game players between 12-30 years with a percentage of 80% aged 12-21 years are teenagers which means high school students are included [6]. The second indicator is the suitability of the learning styles of the students that showed valid result. The learning style includes auditory, visual, and kinesthetic learning styles. The suitability is caused the Chemistry Adventure game that was developed is an audiovisual kinesthetic media that displays sound namely music in the game, moving images in the form of players and enemies that must be faced, as well as the material in the text form so it can overcome the three forms of learning styles of students.

The fourth aspect got a validity percentage of 86.67% in very valid category. The Chemistry Adventure game that was developed has rules that directing students to use the game. Rules are every actions that have been made in the game and cannot be changed by players or users [23]. Rules of game make



the game more interesting. Rules are contained in the game so that when students open the game, students can read and understand it.

The fifth aspect got a validity percentage of 86.67% in very valid category. The Chemistry Adventure game that was developed has general instructions and specific instructions to make it easier for students to play even it is provided in the Chemistry Adventure game guidance book. General instructions for the game can be read on the Home menu while specific instructions are in the form of narratives written at the beginning of each level of the game.

The sixth aspect got a validity percentage of 80.00% in valid category. The Chemistry Adventure game that was developed presents options for students to stop or continue the game. This can be seen when students play or have passed level 3, there is a Home menu that can be chosen to quit of the game or return to play from the beginning of level 1. This made students think in taking the next step.

The seventh aspect got a validity percentage of 86.67% in very valid category. The Chemistry Adventure has certain standards so that students succeed in completing the game well. The first indicator, students must answer 8 correct questions at each level in order to proceed to the next level. Second, in answering questions students are limited by different durations at each level because they are adjusted to the difficulty of level of the questions. Third, in order to be able to rescue Professor Selena, the minimum score that must be obtained by students in answering questions is 168. The existence of these standards is expected to make students feel interested and challenged to play and complete the game.

The eighth aspect got a validity percentage of 86.67% in very valid category. The Chemistry Adventure game can trigger students' interest and activeness in playing while learning. Challenges can be disturbances or threats during play or if they fail in the game [23]. In the Chemistry Adventure game, the challenge was applied to the mission of rescuing Professor Selena, which Krypton figures played by students must face monsters while answering questions and getting a minimum score of 168.

The ninth aspect has two indicators. Each assessment indicator got a validity

percentage of 80.00% in valid category. The Chemistry Adventure game that was developed will provide rewards if students succeed and punish if students fail to play. The game can provide feedback directly [24]. This was applied when students answer questions. If they directly answer the question right, they get a score of 10 and can continue to the next question, but if one time incorrectly answered and then correct, the score is 7, whereas if twice incorrectly answered and then correct, the score obtained is only 3. If students remain incorrectly answer the question until the opportunity runs out, then it must repeat at the beginning of the level.

The tenth aspect got a validity percentage of 86.67% in very valid category. The Chemistry Adventure game that was developed provides choice element in answering questions where the questions presented are multiple choice questions. To avoid trial and error by students in answering questions, the opportunity given is only 3 times and there are differences in the number of scores. The score obtained will affect the success or failure of the mission to rescue Professor Selena so that students will give more consideration in answering the questions.

The eleventh aspect has two indicators, respectively, the assessment indicators got a validity percentage of 80.00% and 73.33%, in valid category. The colors and animations in the Chemistry Adventure game are in accordance with chemistry content and the concept of the game is adventure. This was applied to the different areas at each level. Animation of enemies and background colors used were interconnected and diverse. Likewise with the Lewis structure in the game, valence electrons of atoms were made in different colors for different atoms. These things support the attractiveness of the game developed.

The twelfth aspect got a validity percentage of 80.00% in valid category. The Chemistry Adventure game using Game Maker: Studio software that was arranged in such a way by programmer so it created an effective and efficient game. This program is able to manage all phases of video game development and can be played in various operating systems such as Windows, Mac, iOS, Android, or HTML5 [25].

The thirteenth aspect has two indicators, respectively, the assessment indicators got a

validity percentage of 73.33% and 80.00% in valid category. In the Chemistry Adventure game that was developed, the opening narrative and the plot of game were appropriate. Back sound and sound effects also have been adjusted, for example when students answer incorrectly or correctly, the effects that appear on the game are different, or when the player shoots the enemy, it will sound back sound like a shot. As for the continuity of colors with the background, it also has been arranged so that the text or narration in the game can be read. The narration in the game was arranged so that it is easy to read by students but does not interfere with the course of the game.

Based on the results of the study until the game validation, the Chemistry Adventure game is declared valid and can be tested at next stage.

## 2. Development Stage

The development stage is the stage of game trial. In this study was only carried out until limited trial stage. The trial was conducted to determine the feasibility of the game Chemistry Adventure especially on aspects of practicality and effectiveness as a learning media.

### a. Practicality of Chemistry Adventure Game

The practicality of the Chemistry Adventure game was reviewed of the activities observation and responses of students. The results were described as follows..

#### 1) Result of Activities Observation of Students

Activities observation of students was conducted in 10<sup>th</sup> grade, SMAN 1 Sidoarjo by three observers to eleven small groups of students in the class. Two observers observed the activities of eight groups while one observer observed the activities of three groups. Observation of this activity aimed to find out that the activities of students while using the Chemistry Adventure game are relevant to expectations and know the effectiveness of the game.

The results of the observations showed that almost all activities carried out by students were relevant to expectations, which means the percentage of activity is  $\geq 61\%$ . There is one activity that gets a percentage of 36.36%. The activity is in the form of taking assistance to answer questions on level 3. At level 3 the use of assistance percentage was

very low. There were several possibilities that cause this, among others, students already understood the matter contained in assistance at the first level, students did not have enough points to be exchanged for help, or students deliberately wanted to answer the questions without utilizing the assistance provided. Assistance was indeed used to facilitate students but even if the assistance is ignored it did not mean that the assistance provided was not practical. The assistance used in the game can be reduced its use according to the needs of students as players [26].

Based on the results of the observations was obtained the percentage students activity is 88.06% and relevant to expectations. This showed that the Chemistry Adventure game that was developed is very practical.

#### 2) Result of Students' Response

Data from students' response results were obtained from students' response questionnaires after using the Chemistry Adventure game. The response results were used to find out the practicality of the Chemistry Adventure game. The following were the results of the student response questionnaire presented in Table 4.

**Table 4.** The result of students' response

Indicator	Percentage (%)
The level of interest of students about the game.	88.88
The level of easiness of understanding material.	81.81
The level of easiness of use of the game.	93.93

Based on Table 4, the percentage that was obtained in the first indicator showed the level of interest of students in the Adventure Chemistry game is high. The pleasure of using games, the desire to use them again, and the act of recommending games to other friends are indicators that students felt interested in using the Chemistry Adventure game. The percentage that was obtained in the second indicator showed that the matter in Adventure Chemistry game is relatively easy to understand and this is supported through the easiness of doing the posttest. The percentage that was obtained in the third



indicator showed that the Chemistry Adventure game is easy to use. The easiness related to the easy operation of the game because all menus function properly, the narration in the game is easy to read, instructions and regulations was made easy to be understood by students so Adventure Chemistry game is very practical to use.

Based on the results of students' responses to the Chemistry Adventure game, it was classified as very good which can be seen in each indicator got percentage of >81%. The average percentage of students' responses was obtained 89.00% is classified as very practical.

#### b. Effectiveness of The Chemistry Adventure Game

The effectiveness of the Chemistry Adventure game was reviewed of learning outcomes and students' interest in learning. The results were described as follows.

##### 1) Result of Students' Learning Outcomes

Data of results of students' learning outcomes were fixed through the pretest and posttest in the form of written test. The test was conducted by giving 15 multiple choice questions before and after the use of the Chemistry Adventure game. There were differences in values from pretest and posttest. The value of the pretest that was obtained by students showed that incompleteness happen to all of students. After using the Chemistry Adventure game and doing the posttest, almost all of students was pass. As many as three students did not pass while 30 students passed. Students are declared pass if they have achieved the minimum completeness criteria [19]. As many as 90.91% of students has passed. Based on the learning results that was obtained, the Chemistry Adventure game fulfilled the aspects of effectiveness in very effective category.

##### 2) Result of Students' Interests in Learning Questionnaire

Students' interest in learning questionnaires were given after using the Chemistry Adventure game. The following were the results.

**Table 5.** The result of students' interest in learning questionnaire

Indicator	Percent. (%)
Pleasure in learning.	84.64

Indicator	Percent. (%)
Interest in the learning process.	83.02
Participation in learning activities.	83.63

Based on Table 5, the first indicator of students' interest in learning was obtained an average percentage of 84.64%. This is suit with expectation that learning use game must be based on pleasant learning in addition to provide learning matter [27]. Feelings of pleasure that arise in learning is one indicator that students were interested. With the presence of pleasure, students will pay attention without realizing it and enjoying the continuity of the learning process.

The second indicator of students' interest in learning was obtained an average percentage of 83.02%. This game is one of the media that can be used by students to support the effectiveness and efficiency of the process of studying the matter of the Chemical Bonding. Students who are interested in the learning process will have a fixed tendency to pay attention and remember something that is studied continuously [28].

The third indicator of students' interest in learning was obtained an average percentage of 83.63%. Learning media in the form of games have the advantage that the game allows the active participation of students to learn [1]. Games in learning will make students feel happy and encourage learning harder.

Based on the results of students' interest in learning using the Adventure Chemistry game is relatively high so that the Chemistry Adventure game fulfilled the effectiveness aspect.

#### CLOSURE Conclusion

Based on the results of the research and discussion that was presented in the previous and adapted to the formulation of the problem, it can be concluded that the Chemistry Adventure game that was developed is feasible as a learning media on Chemical Bonding matter for 10<sup>th</sup> grade high school. This is based on fulfilling the feasibility aspects, namely as follows.

1. Chemistry Adventure game as a learning media on Chemical Bonding matter was declared valid on aspects of content validity and constructs validity which obtained a percentage of 73.33% to 86.67% in valid to very valid category for each indicator based on the results of assessment by experts .
2. Chemistry Adventure game as a learning media on Chemical Bonding matter was declared very practical based on the results of observations of student activities carried out by observers and the results of student responses to the use of Chemistry Adventure game. The results of the observations of student activities gained an average percentage of 88.06% while the response results of students obtained an average percentage of 89.00%.
3. Chemistry Adventure game as a learning media on Chemical Bonding matter was declared effective based on learning outcomes and students' interest in learning. The learning outcomes of students in the posttest obtained a percentage of classical completeness of 90.91% while the results of learning interest of students gained an average percentage of 83.76%.

### Suggestion

Based on the results of the research and the conclusions above, the researcher conveyed several suggestions for the next researcher to get better results. These suggestions is provided as follows.

1. In this study, the testing of the Chemistry Adventure game was developed only until the limited trial stage, so that to obtain more extensive and more accurate information and results, this Chemistry Adventure game can be continued until the wider trial stage.
2. During the testing of the Chemistry Adventure game, the allocation of time and class management must be considered carefully so that students can understand the matter presented in the game optimally.
3. Learning that is done use the Chemistry Adventure game as a computer based learning media in the Chemical Bonding matter has never been done in schools, therefore it is expected that it can later be applied in schools.

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